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A CASE STUDY OF 5S IMPLEMENTATION IN INSPECTION PROCESS

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ABSTRACT

5S is a lean tool which involves workplace organization and is implemented to reduce the searching time of a product. The methodology adopted in this paper is the 5S pillar approach: Seiri, Seiton, Seiso, Seiketsu, Shitsuke to increase the overall efficiency of the process. The result of implementation of each step of the 5S methodology at XYZ Limited is also shown in this paper. The 5S methodology is applied to solve the problems in inspection department of the forging industry producing several crankshafts with the aim to eliminate losses in the company. The existing problem of the company is dealt with is messy tool setting, bad working environment and inefficient process flow. The company cannot meet customer's demand and works inefficiently, because everyone in the company is not used to a clean working environment and all inventory interrupts the process flow; therefore the major objective of this study is to help company not only to rearrange but also reset the working environment and enhance the process flow by using 5S tools. After implementing of 5S in the inspection department the time saving is 39.60% and also certain process wastes are reduced. The inspection department in the workplace became neat and effective.

KEYWORDS: 5S, Crankshafts, Efficiency & Inspection

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Original Article

INTRODUCTION

The main objective of this research is the application of 5S tools in the inspection of crank shaft. Lean is defined as systematic elimination of wastes and lean thinking principles are : Defining value of the products, Identifying value and non value added activities, Eliminate non value added activities and make the value creating steps flow, Let the customers pull, pursue perfection. Most commonly used Lean tools are Value Stream Mapping, 5S, Set up reduction, Kanban, Heijunka, Visual controls and Kanban. Many companies that undergo lean transformation starts with 5S tools as it is a basic technique that exposes hidden problems in the form of waste which can be minimized and other lean tools can successively be implemented. 5S stands for Seiri(Sort), Seiton(Set in order), Seiso(Shine), Seiketsu(Standardize) and Shitsuke(Sustain). 5S enables one to comprehend the status of production area by simple observation without the use of computers. The 5S philosophy focuses on simplification of the work environment, effective workplace organization, and reduction of waste while improving safety, efficiency and productivity. The 5S technique is a structured program to systematically achieve total organization cleanliness and standardization.

LITERATURE REVIEW

Shahryar Sorooshian et al.(2012) implemented 5S philosophy to achieve a designated location for each item[1]. Harsha Lingareddy et al (2013) carried out inspection process based on 5S checklists in order to improve

the efficiency in production [2]. Khedkar et al (2012) implemented 5S techniques in the plastic moulding industry to enhance safety, productivity and efficiency [3]. J. Michalska et al. (2007) proposed 5S rules and implemented these rules in production process. The training of the workers in this 5S rules in order to achieve continuous improvement [4]. Gheorghe Dulhai (2008) proposed a process based continuous improvement strategy to improve manufacturing at auto car exhaust. The "5S" rules, is implemented at the middle and bottom levels of the organization which is coordinated and helped by the superior management [5]. Soumya et al (2015) contributed step by step implementation guideline for successfully practising 5S as a part of daily practice. Also a method is adopted using the 5S pillar approach to improve the overall performance [6]. Agrahari et al (2015) implemented 5S methodology in a small scale industry to achieve housekeeping and productivity. A case study was presented using 5S methodology and questions were asked to workers and their feedback was implemented to increase the storing place [7]. SaadShaikh et al (2015) implemented 5S methodology in small industry where filters are manufactured. The effectiveness of implementation before and after 5S was analyzed and compared in order to improve environmental conditions, health and safety standards [8]. Shinde D. B and Shende P. N implemented 5S methodology in an industry to improve the plant layout to increase employee morale and maintenance, shorter lead times [9]. Carvalho et al (2011) implemented 5S methodology to facilitate easy finding of raw materials and tools to achieve reduced motions and waits [10]. Reuben B. R et al (2014) implemented 5S methodology to remove unwanted materials. A 5S kit was provided to minimize the duration of time spent on searching the tools [11]. Patel et al (2015) performed an analysis of improvements about different manufacturing industries to decrease inventory, more utilization of space and reduce wastages [13]

RESEARCH METHODOLOGY

The 5S tools are applied in the inspection department in the manufacturing of crank shaft. Each phase of 5S tool is applied in the sequence for a total duration of 6 months. Data is collected by visual observation for the following activities magnetic inspection, demagnetization and visual inspection for different staff members and a stop watch was used to measure the time taken. The data taken period was from November 2017 to April 2018. A 5S implementation time line is shown in Table 1 below:

Table 1: 5S Implementation Time Line

5S	Activities	Period
Phase before 5S Training	Explain 5S Technique	2 weeks
5S implementation (sort phase)	Separate needed and not needed items, determine root causes of dirt	4 weeks
5S Implementation (Set in order phase)	Arranging the needed items and labeling items	4 weeks
5S Implementation (Shine phase)	Cleaning the workplace and equipment	4 weeks
5S Implementation (Standardize phase)	Write and set Standard operating procedures and marking floor	4 weeks
5S Implementation (Sustain phase)	Conducting 5S audit and set standards	4 weeks
After 5S implementation phase	Measure the results	2 weeks

A method commonly used by a manufacturing company to achieve an effective, efficient, and organized work environment, so as to boost productivity, reduce cost, and improve quality standards. 5S include five Japanese word which are seiri, seiton, seiso, seiketsu, and shitsuke.

5S programs have been implanted in organizations and the world as a way to improve production values while also improving employee morale and safety. The 5S methodology may be applied to most workplace scenarios in a short

period of time due to its simple nature. The before and after picture are taken for implementation of 5S methodology in a company.

Sort (Seiri)

- Sort focuses on eliminating unnecessary items from the workplace that are not needed for current operations.
- Make work easier by eliminating obstacles.
- Remove all parts or tools that are not in use.

Set In Order (Seiton)

- Set in order focuses on creating efficient and effective storage methods to arrange items so that they are easy to use and label them so that they are easy to find and put away.
- Arrange all necessary items so that they can be easily selected for use

Shine (Seiso)

- The general idea is to make everything in the workplace clean, shiny and neat.
- Prevent machinery and equipment deterioration.
- Keep workplace safe and easy to work.

Systematize (Seiketsu)

- Standardize is prevention – preventing accumulation of unneeded items, preventing procedures from breaking down, and preventing equipment and materials from getting dirty.
- Maintain orderliness. Maintain everything in order and according to its standard.

Standardize (Shitsuke)

- Sustain is the final step for 5Simplementation, and ask the executives to keep everything going every day.
- Making workers do sort, set in order, shine and standardize when they are running the four Ss daily, means that they are completing sustain.

CASE STUDY

An XYZ Limited produces different types of products that require various sizes of crank shaft, cam shaft and tools.

The crankshaft taken for inspection was single throw and multi cylinder crankshaft (6 cylinder crankshaft) whose weight weighs 140kg

In the following section how the company used each of five pillar: Sort, Set in order, Shine, Standardize and sustain to successfully implement 5S is given

Sort

Initially the inspection department occupied large space, not organized and untidy. A red tag campaign team was formed. The members of red tag team separated unnecessary items and necessary items in the inspection department. The team then placed red tag on items that were not used. As a result of this sort phase, the used space became free and all the unnecessary items were disposed.

Set in Order

After sorting phase, the necessary items that remained were arranged according to the job requirement in each station. A designated area was assigned and left out necessary items were placed accordingly. This resulted in reducing searching time. A visual approach was used as possible to ease the organization process and make work easier for the worker.

Shine

After the Set in order phase, the inspection department was cleaned. The cleaning supplies shadow board was used to find cleaning supplies. This has resulted in minimizing searching time. When cleaning the workstation the associates were able to find abnormalities in workstation so that one can fix the deviations. This has resulted in associates keeping their workstation clean.

Systematize

The associates from the company cleaned their workstation as part of their daily routine. At the end of every week, a detailed cleanup is performed. This has resulted in maintaining high standards of cleanliness and neat workplace. A plan was developed to perform routine practices for cleaning and checking. Each and every worker were given a task to perform daily clean up activity.

Standardize

At this final stage of 5S, the inspection department has established standards for each step of 5S and has acquired self-discipline. An assessment was created for the successful implementation of 5S process. Each and every month the observation was carried out and result analysis was performed.

ANALYSIS AND FINDINGS

Time Analysis in Inspection of Crank Shaft

Time utilization was taken each time the personnel or staff carried out the final inspection of crank shaft starting from magnetic flaw detector to visual inspection. In order to know how much efficiency got increased after 5s implementation, the calculations are provided. Table 2 shows time taken during inspection of crankshaft before implementing 5S. Table 3 shows time taken during inspection of crankshaft after implementation of 5S.

Table 2: Time Taken during Inspection of Crank Shaft before 5S (in seconds)

Staff	Magnetic Flaw Detection (sec)	Demagnetization (sec)	Visual Inspection (sec)	Total Time (sec)
Staff 1	71	22	8	101
Staff 2	73	20	10	103
Staff 3	73	21	12	106
Staff 4	68	19	11	98
Staff 5	65	22	9	96
Average Time Taken				**101**

Table 3: Time Taken during Inspection of Crank Shaft after 5S (in seconds)

Staff	Magnetic Flaw Detection (sec)	Demagnetization (sec)	Visual Inspection (sec)	Total Time (sec)
Staff 1	41	22	8	71
Staff 2	43	20	10	73
Staff 3	43	21	12	76
Staff 4	38	19	11	69
Staff 5	45	22	9	76
Average Time Taken				**61**

XYZ limited operates at three different shifts from shift 1: 8: 00 am to 4:00 pm, shift 2: 4:00 pm to 12:00 am, shift 3: 12:00 am to 8:00 am. Initially before the implementation of 5S, all the staffs were not multiskilled on inspection methods and 5S methods. All the staffs were trained on 5S methodologies and inspection methods using 5S videos and on job training during the implementation phase. After the implementation of 5S, all the staffs became multiskilled on inspection methods and 5S methodologies. This resulted in reduction of inspection time after 5S implementation. The study conducted chose 2 staff from first shift, 2 staff from second shift and 1 staff form third shift.

The crankshaft inspection involves the need to check for flaws (cracks). These cracks are determined by three inspection methods at XYZ company. They are magnetic flaw detection, demagnetization and visual inspection. Therefore the times taken for each inspection method are measured using stop watch before and after implementation of 5S. A detailed cost analysis is given before and after implementation of 5S

The salary per staff = Rs 25000/ month (25 days)

Salary per hour = 25000/ (25 x 6) = Rs.166

Number of hours per day spent by 3 workers for 3 shift = 18 hours

Before 5S

Total Expense = 1000 x 3 = Rs 3000

Number of specimen undergoing inspection = 648

Cost expenditure per unit specimen = Rs 4.6

After 5S

Number of specimen undergoing inspection = 928

Cost expenditure per unit specimen = Rs 3.2

Cost efficiency = (4.6 – 3.2)/ 4.6 = 30%

Efficiency Calculation for Time

Efficiency = ((Average Time Before 5S)-(Average Time After 5S)/ (Average Time Before 5S)) * 100

Efficiency = (101)-(61)/101 100

=39.60 %

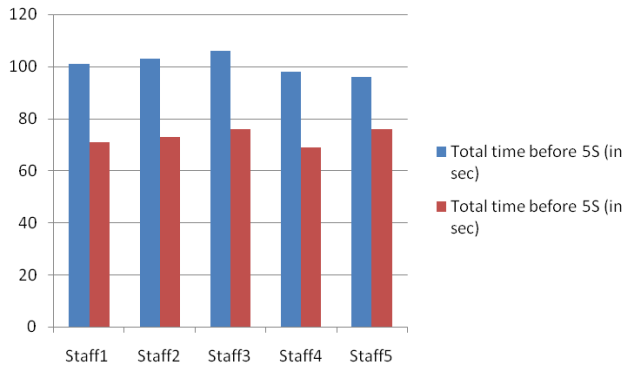

Figure 1: Comparison of Time Taken during Inspection of Crankshaft before and after 5S

CONCLUSIONS

After the successful implementation of 5S methodology the time taken for the inspection of crankshaft is reduced to 71 seconds from 101 seconds for staff1, 73 seconds from 103 seconds for staff 2, 76 seconds from 106 seconds for staff3, 69 seconds from 98 seconds for staff4, 76 seconds from 96 seconds for staff5. Due to implementation of 5S, abnormalities were highlighted, problems were observed visually and hence action plan were taken to be solved.

Abnormalities refers to defects that arises when dirt is mixed up in the production. The number of accidents happened in the industry were reduced. Before the implementation of 5S the number of accidents happened was 5 per year and it accounted for bad housekeeping. After the implementation of 5S, number of accidents reduced to 2 per year. There was improvement in time utilization. However the 5S implementation tools can be applied to the entire manufacturing process of crank shaft and not limited to inspection process alone. The future work will involve the application of 5S tools in service sector and lean office concept may be applied.

BIOGRAPHY

Karthik Subburaman is an Assistant Professor in the Department of Mechanical Engineering at the Veltech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology. He earned B. E in Mechanical Engineering from Anna University, Chennai, India and Masters in Industrial Engineering from the University of Tennessee at Knoxville, U. S. A. He had published journal and conference papers.

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